



**Planned GEO Mission in Korea
for Air Quality Measurements :
GEMS(Geostationary Environmental
Monitoring Spectrometer)**



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More to invite...



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 3. Next GEO Mission, MP-GEO SAT (Multi Purpose Geostationary Satellite)
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Asia – important region in Global AQ

Both Anthropogenic and Natural Sources throughout the year

Anthropogenic

Geogenic

Biomass burning

Biogenic



Pollution

Industry
Transportation
Mega Cities



Asian dust

Land use change
Desertification
Population(>60%) – Social benefit



wild fires

Drought



sink change

Deforestation



Monsoon



Typhoon



Tsunami

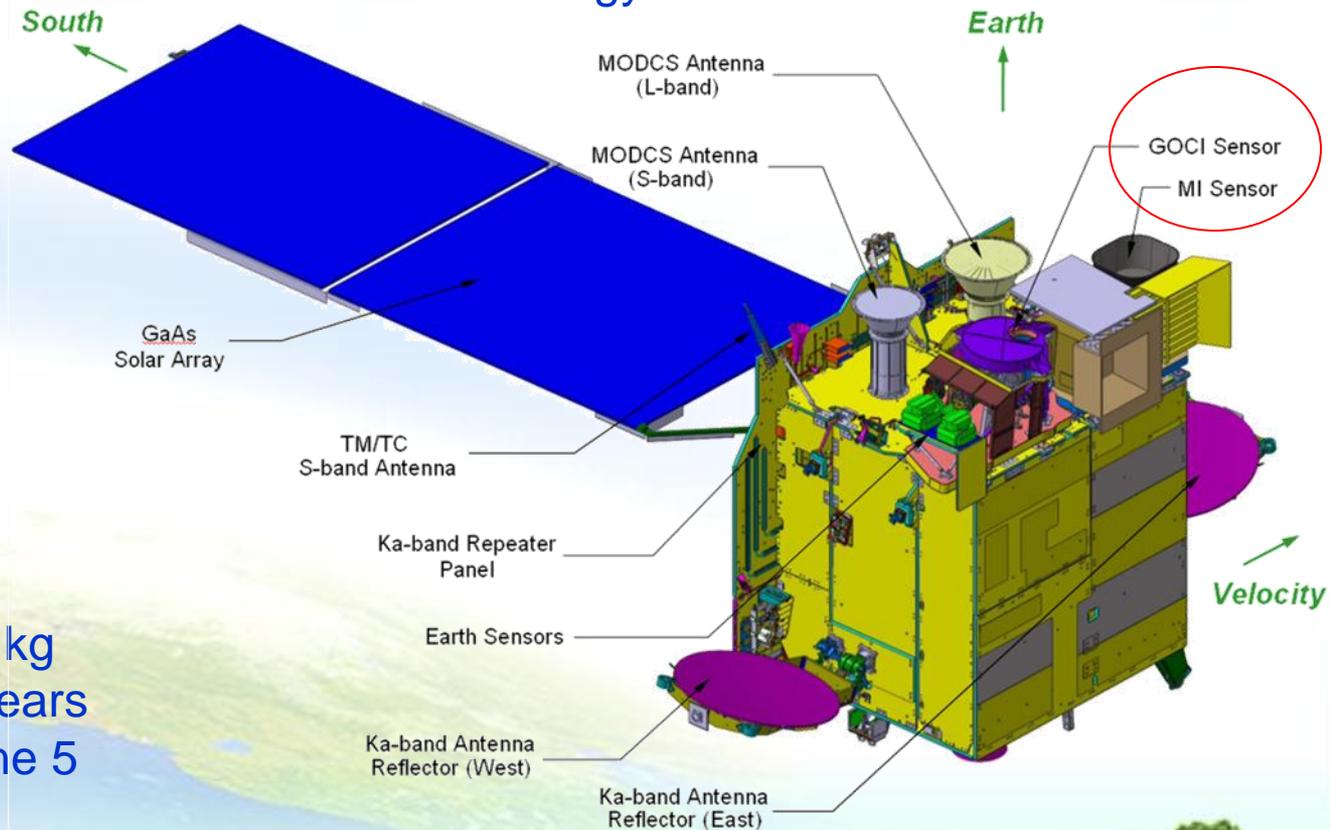
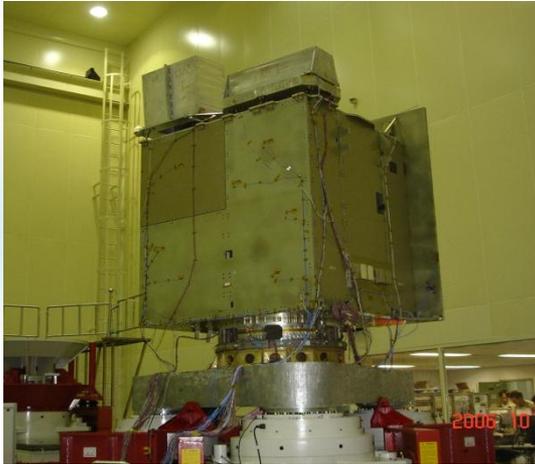


Tibetan Plateau



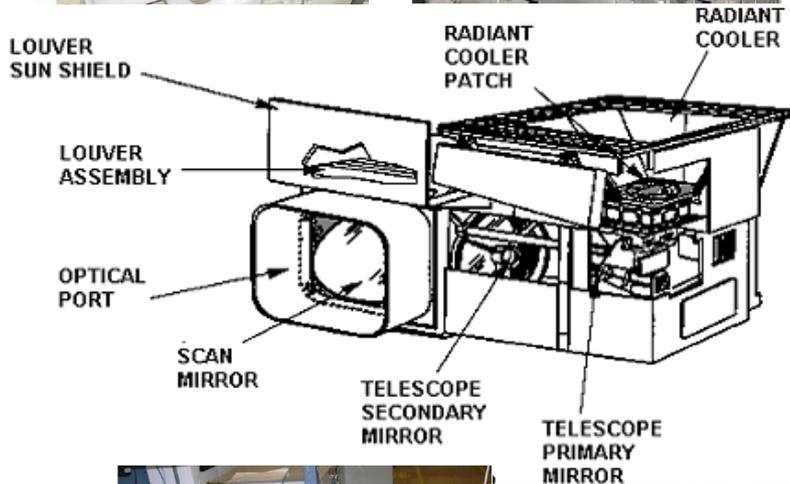
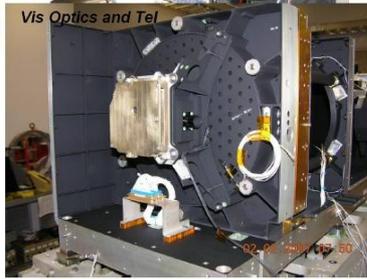
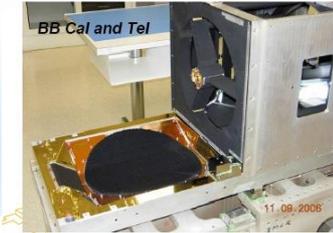
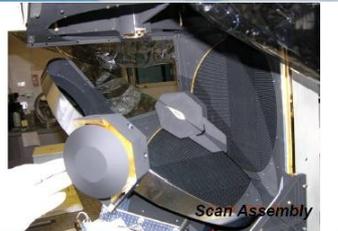
COMS

- Mission:
 - Communication
 - Ocean Color
 - Meteorology



- Launch: Nov., 2009
- Orbit: GEO (128.2°E)
- SI: KARI + Astrium
- Mass at launch <2497 kg
- Operational life : 7.7 years
- Launch vehicle : Ariane 5

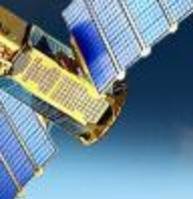
Meteorological Imager(MI)



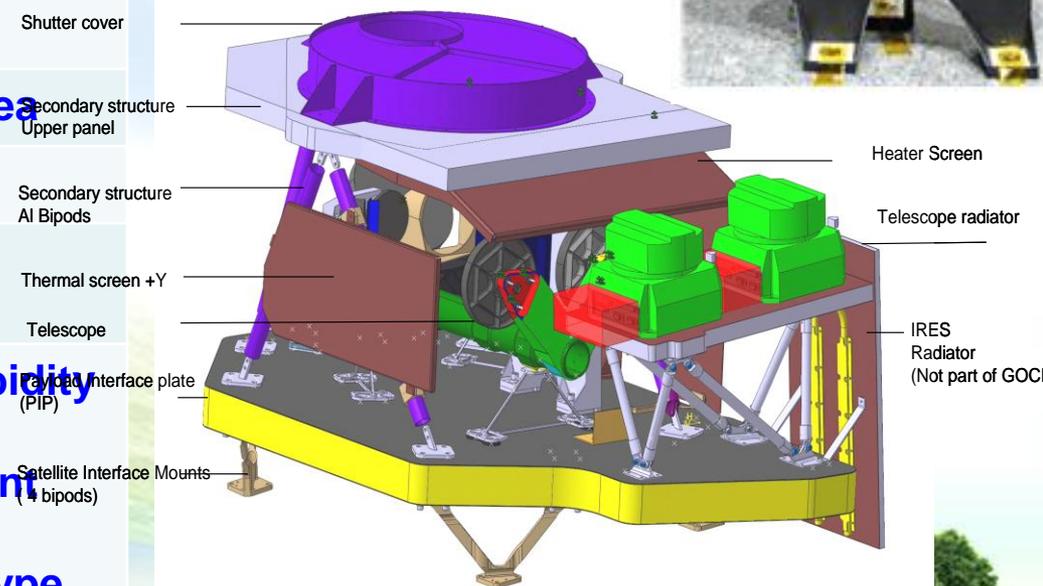
	MI
Mass	144.6 Kg
Volume	130x90x80 cm ³
Spectral Band (μm)	0.63(0.55-0.75) 3.91(3.8-4.0) 6.7(6.5-7.0) 10.7(10.2-11.2) 12.0(11.5-12.5)
Spatial Resolution	1 km (VIS) 4 km (IR)
Coverage	Global
SNR	~
Temporal Resolution	30 min.
Products	Cloud, snow cover, CSR, OLR, AMV, SST, LST, TPW, Fog, CTT, CTP, rain rate, AOD



GEO Ocean Color Imager(GOCI)



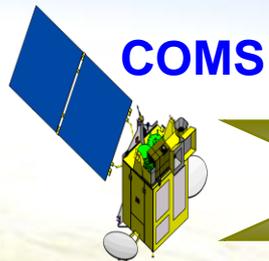
	GOCI
Mass	83.3 Kg
Spectral Band	412, 443, 490, 555, 660, 680, 745, 865 nm (8)
Spectral Resolution	20 nm (B1~B5, B7) 10 nm (B6) 40 nm (B8)
Spatial Resolution	500 m x 500 m
Coverage	East Asia near Korea
SNR	~1000
Temporal Resolution	1 hour (8/day)
Products	Yellow substance turbidity Chlorophyll suspended sediment Vegetation AOD, aerosol size, type



MP-GEO SAT Development Plan 환경부

■ The continuity of COMS missions

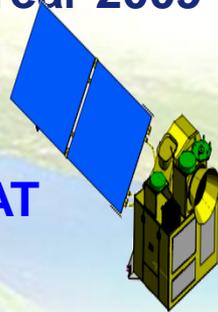
- COMS program : Launch at 2009, the predicted end of life in 2016
- For the continuous mission of meteorological and ocean color monitoring, the next satellite should be launched no later than 2016.



COMS



MP-GEO SAT



Feasibility Study of MP-GEO Mission

■ Feasibility study:

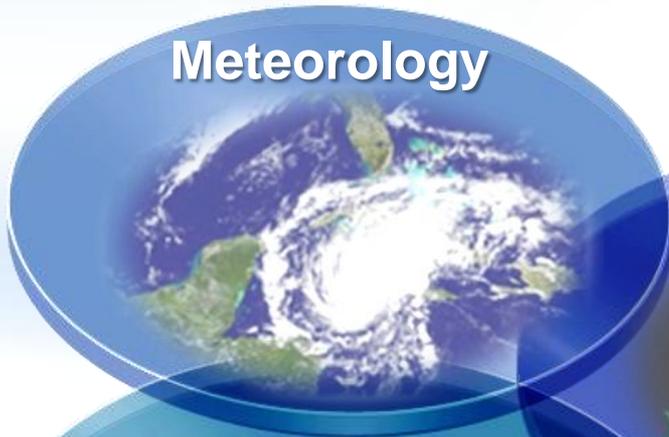
- Finished feasibility study of Geostationary Environment (AQ) Monitoring Mission
 - P.I. : Jhoon Kim (Yonsei University), 2008, ME
 - Recommended measurements of SO₂, NO₂, O₃ and aerosol using UV/Visible spectrometer from Geostationary Orbit
 - As an option, recommended measurements of CO, CO₂ and CH₄ using IR FTS from GEO
- Finished feasibility studies of meteorological and ocean color monitoring mission
- Finished feasibility study of next Geostationary Mission
 - P.I. : Y.K. Chang (Korea Aviation University), Aug. 2008 – Feb. 2009, MEST
 - Recommended Atmospheric Environmental Monitoring Mission, together with Meteorological and Ocean Color Monitoring

Mission of Next GEO Satellite

MP-GEO SAT after COMS

Launch in 2016

Meteorology



Ocean Color



Air Quality



Environmental Mission Objectives

■ Air-quality:

- To provide global measurements with sufficient temporal resolution together with Meteorological mission
 - Globalization of tropospheric pollution
- To assess and forecast air quality
 - Monitoring, Validating CTM, improving accuracy
 - Emission Inventory from hourly measurements of concentration from space
- To monitor regional transport events
 - Transboundary pollution: pollution, Asian dust
- To understand long-term effect of aerosols in climate change
 - Aerosols and their precursors for long term

■ Social Benefit:

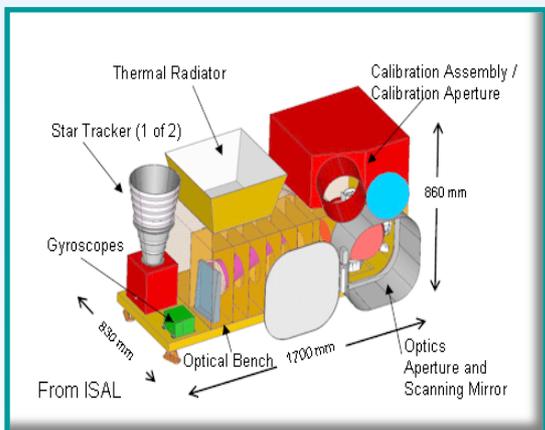
- Reducing economic loss by improving prediction of climate change
- Reducing medical costs and death rates through early warning of pollution events



Environmental Payload onboard MP-GEO

GEMS(Geostationary Environment Monitoring Spectrometer)

Scanning UV/VIS Spectrometer (SUVS)



- Heritage from OMI
- Completed technical feasibility thru NASA IIP

(Bhartia, 2009)

Spectral Range		300-500 nm (Resolution: 0.8 nm)
Spatial Resolution		5 km(N-S)×15 km(E-W)
Vertical Resolution		3~6km
Global Coverage		1 hour
SNR		1500:1 at 430nm
Spec-ification	Power	<100 Watts
	Weight	< 50 Kg
	Volume	0.5 x 0.5 x 0.25 m ³

Ocean Color Imager (GOCI-2)

■ Spectral Bands Requirements

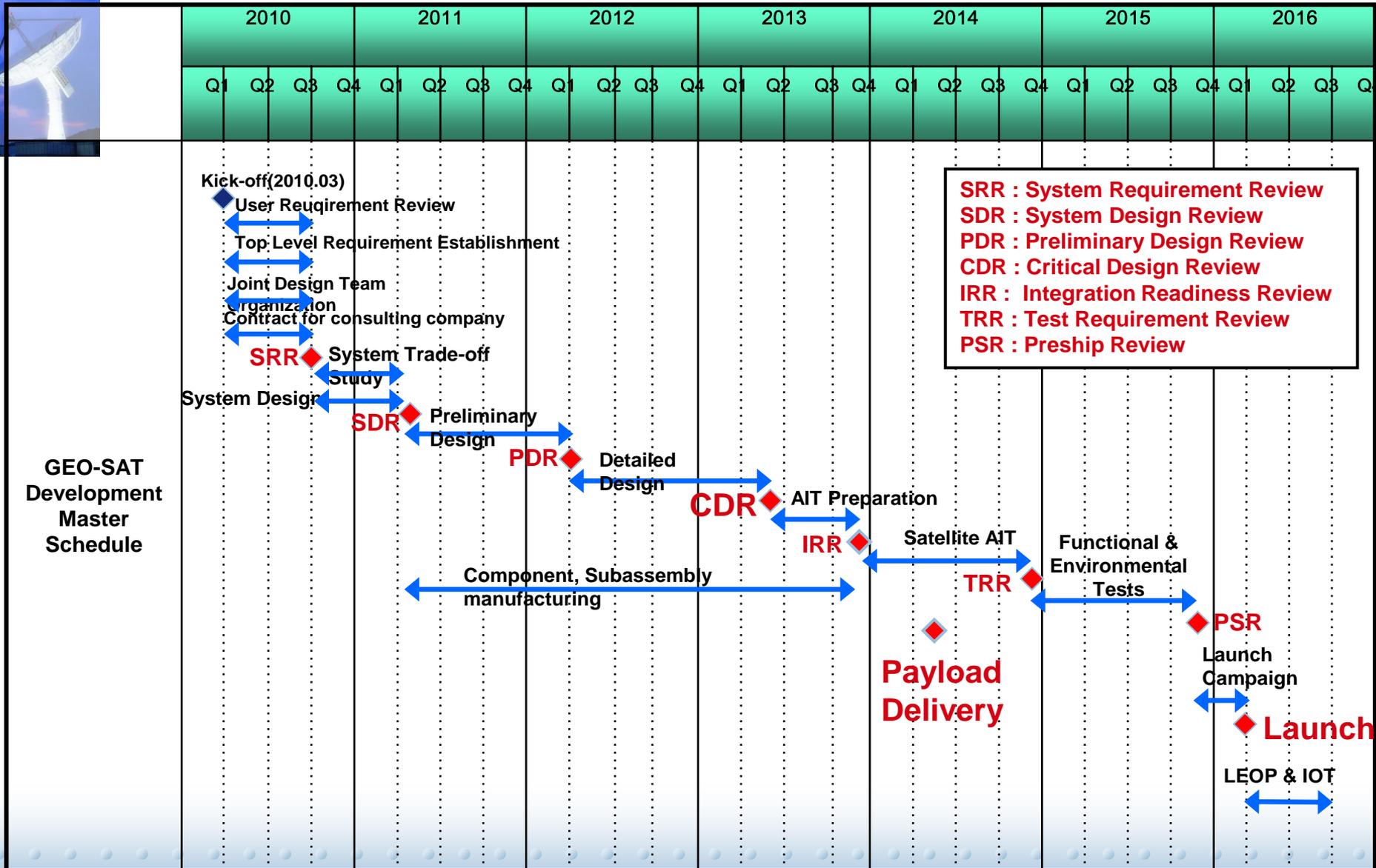
- **13 Bands** (GOCI-1 : 8 Bands)

- Phytoplankton type verification, Nighttime Observation, Enhanced Atmospheric Correction Accuracy

Radiance : W/m²/um/sr

Band	Heritage	Band Center	Band width	Nominal Radiance	Maximum Ocean Radiance	Saturation Radiance	Maximum Cloud Radiance	NEdL	SNR	Primary use
1	GOCI-B1	412nm	20nm	100.0	150.0	152.0	601.6	0.100	1000	Yellow substance and turbidity
2	GOCI-B2	443nm	20nm	92.5	145.8	148.0	679.1	0.085	1090	Chlorophyll absorption maximum
3	GOCI-B3	490nm	20nm	72.2	115.5	116.0	682.1	0.067	1170	Chlorophyll and other pigments
4	(KGOCI)	520nm	20nm							Red Tide
5	GOCI-B4	555nm	20nm	55.3	85.2	87.0	649.7	0.056	1070	Turbidity, suspended sediment
6	(KGOCI)	625nm	20nm							SS & Red Tide
7	GOCI-B5	660nm	10nm	32.0	58.3	61.0	589.0	0.032	1010	Baseline of fluorescence signal, Chlorophyll, suspended sediment
8	GOCI-B6	685nm	10nm	27.1	46.2	47.0	549.3	0.031	870	Atmospheric correction and fluorescence signal
9	GOCI-B7	745nm	20nm	17.7	33.0	33.0	429.8	0.020	860	Atmospheric correction and baseline of fluorescence signal
10	(KGOCI)	765nm	20nm							Aerosol Properties, Atmospheric Properties
11	GOCI-B8	865nm	40nm	12.0	23.4	24.0	343.8	0.016	750	Aerosol optical thickness, vegetation, water vapor reference over the ocean
12		905nm	40nm							Atmospheric Properties, Cloud Properties
13		650nm	500nm	6.5E-6						Night Band (Night time fishing boat activities)

Master Schedule of MP-GEO SAT

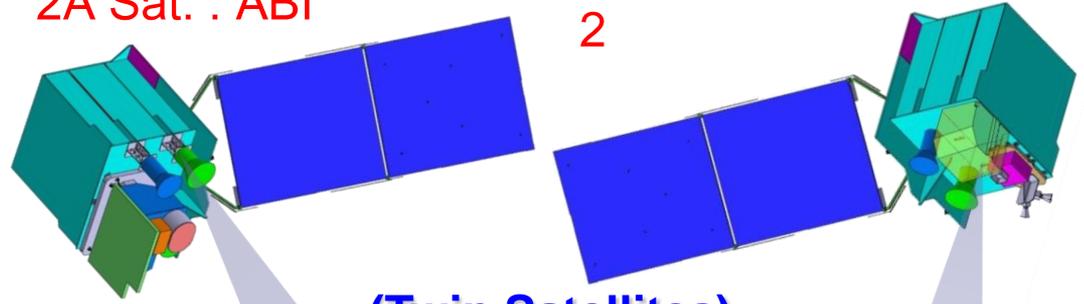


MP-GEO SAT Configuration



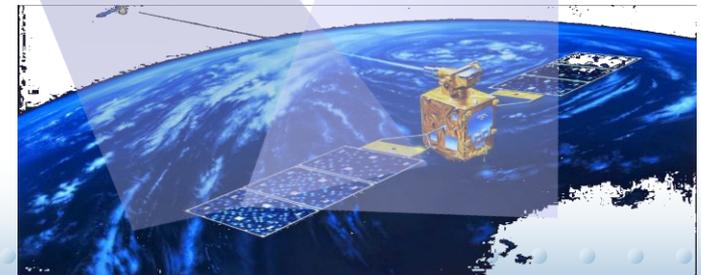
2A Sat. : ABI

2B Sat. : GEMS, GOCI-2



(Twin Satellites)

- ◆ **GEMS and GOCI-2 now have more volume and mass budget**
 - Can increase capability in spatial resolution or spectral coverage
- ◆ **Mission : Air Pollution Monitoring
Meteorological observation
Ocean Color monitoring**
- ◆ **Mass : Dry mass 1280.9 kg
Launch mass 2640 kg**
- ◆ **Power : In-orbit 1500 W, Transfer orbit 1100 W**
- ◆ **Mission Life : 10 years**



Satellite Orbit Options

	LEO	LEO Constellation	GEO	GEO Constellation
Altitude	< 1000 km	←	> 36000 km	←
Time Resolution	Several to 24 hrs	(+) ←	Up to minutes	←
Spatial coverage	Global	←	60S- 60N (lat.), ~120° in longitude	60S- 60N (lat.), Global
Viewing Options	Nadir, Limb, Occultation	←	Nadir only	←
Techniques	Multispectral, multi-angle, polarization, stereo-viewing	←	Multi-spectral only	Multi-spectral, stereo-viewing,...



Global Environmental Monitoring

Constellation of GEO Mission to study Air Quality

SUVS
GEO-CAPE
(America)

EPA



GEMS
MP-GEO
(Asia Pacific)



ME

EEA



GMES S4 UVN
MTG
(Europe)

Constellation synergy

- Improving spatial and temporal coverage
- Monitoring globalized pollutants
- sharing data and science
- supporting QA and CAL/VAL of instruments

Status of MP-GEO SAT

■ Global Environmental Satellite Program Office

- Established in June, 2009 by ME (P.M. : Sukjo Lee, GERC, ME)
- First phase funding started for requirements of science and instrument, algorithm development strategy, and evaluation of social benefit
- Research Center established at Yonsei University, in March, 2009

■ Collaboration discussed at the Korea(MEST)-U.S.A.(NASA) Bilateral Meeting

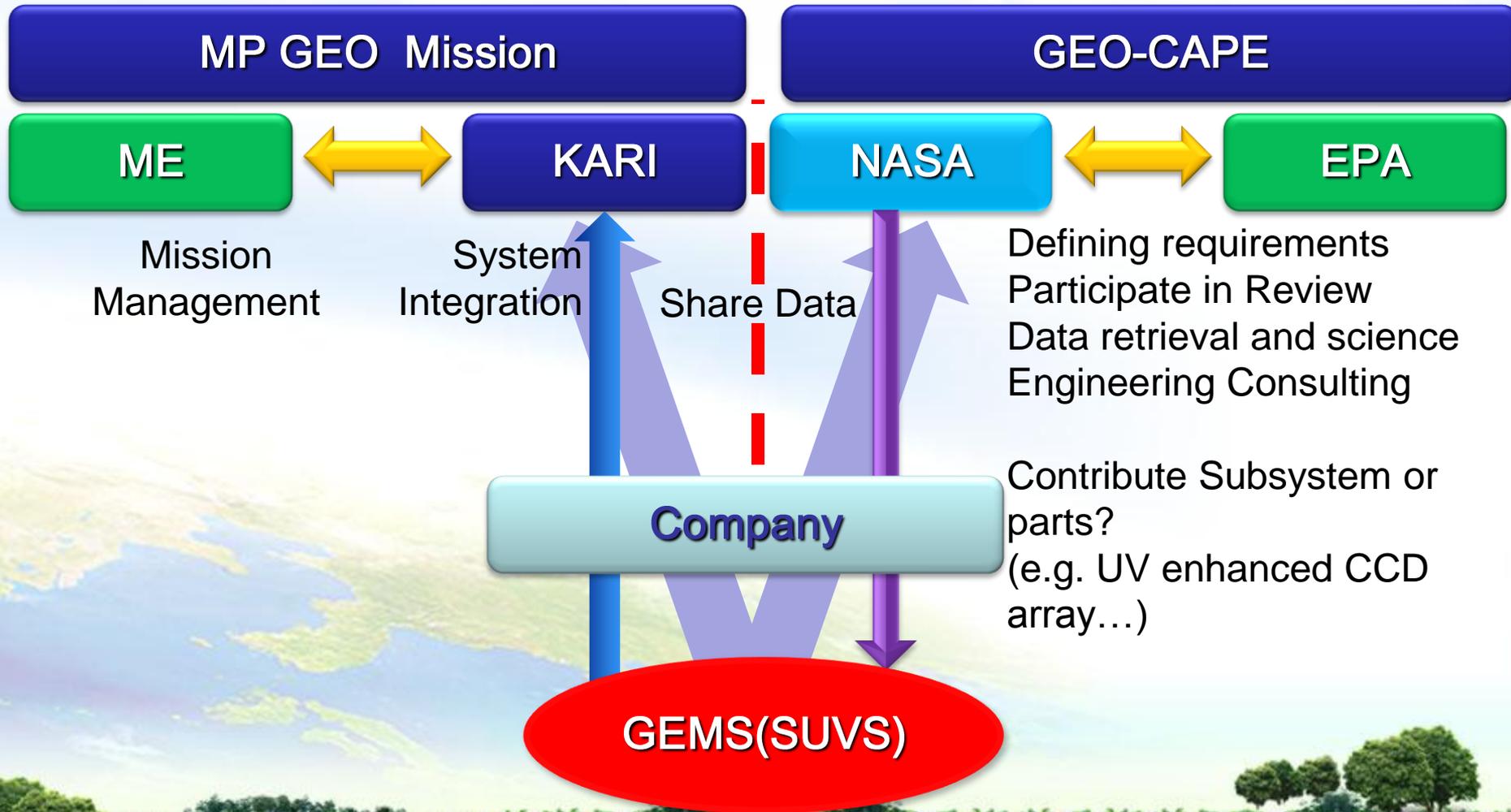
- Delegation from NASA on April 21-22, 2009, at KARI, Daejeon, Korea
- “Satellites and instruments of mutual benefit” for innovative observations of the global integrated Earth system, including:
 - geostationary satellite: **air quality and ocean color observation**
- Recommended to establish joint KARI-NASA working group (WG)
- Next U.S.A.-Korea Bilateral Meeting planned at the end of August, 2009

■ Currently under Preliminary Investigation of Financial Budget

- Requested USD 600 M for the mission
- Final decision pending due to technical feasibility and social benefit

Collaboration between KARI and NASA

Global Air Quality Monitoring from GEO



Summary

- **Suggest collaboration between GEO-CAPE and MP-GEO SAT for trans-Pacific AQ monitoring in:**
 - defining requirements of science and instruments
 - data processing and sciences
 - quality assurance of the same instruments including calibration and validation
 - securing budget from respective government
 - demonstrating and proving technical feasibility in GEO
- **Flight opportunities in GEO over Asian region :**
 - KARI provide spacecraft with launch service
 - KARI and ME are responsible for the GEMS payload,
 - and/or NASA provide support for the payload
 - including science, consulting, quality assurance
 - (participating in reviews), and contributing subsystem



Issues

- **Need Agreements between NASA and MEST/ME/KARI :**
 - to discuss and collaborate in setting up requirements of science and instruments in depth
 - to secure funding from government
 - . Major issues in technical feasibility
 - to receive OMI data in real time for data processing and demonstration
- **Flight opportunities in GEO over Asian region :**
 - KARI provide spacecraft with launch service
 - KARI and ME are responsible for the GEMS payload,
 - and/or NASA provide support for the payload
 - including science, consulting, quality assurance
 - (participating in reviews), and possibly contributing subsystem



THANK YOU

